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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/512,378	02/25/2000	Oscar Chi-Lim Au	016660-038	7227

21839 7590 09/25/2006

BUCHANAN, INGERSOLL & ROONEY PC
POST OFFICE BOX 1404
ALEXANDRIA, VA 22313-1404

EXAMINER

THOMPSON, JAMES A

ART UNIT	PAPER NUMBER
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2625

DATE MAILED: 09/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/512,378

Applicant(s)

AU ET AL.

Examiner

James A. Thompson

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 May 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-9 and 11-22 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-9 and 11-22 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 February 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Re-Opening of Prosecution

1. Based on the Pre-Appeal Conference Request of 15 May 2006, the prosecution as to the merits of the application has been re-opened. A detailed action follows.

Response to Arguments

2. Applicant's arguments, see the Pre-Appeal Conference Request, filed 15 May 2006, with respect to the prior art rejections have been fully considered and are persuasive. The prior art rejections set forth in the final rejection of 15 December 2005 have been withdrawn.

Claim Rejections - 35 USC § 101

3. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

4. Claims 1 and 18 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 1 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 1, a defining step and multiple iterations of obtaining steps are performed on pixel data, pixel data simply being internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 1, as presently recited, does not produce a concrete,

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tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 1 does not have a substantial practical application since claim 1 is merely an algorithm that manipulates information. Claim 1 is therefore directed to an abstract idea, and not a practical application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187, 209 USPQ at 8). Since claim 1 is an abstract idea, and not a process, machine, article of manufacture, or composition of matter, claim 1 is non-statutory. Further, claim 18 depends from claim 1, and is also a merely an algorithm which manipulates descriptive data.

5. Claims 2-9, 11-12 and 19 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 2 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 2, a defining step, a significance coefficient deriving step, and a reconstructed value deriving step are performed on pixel data, pixel data simply being internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 2, as presently recited, does not produce a concrete, tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 2 does not have a substantial practical application since claim 2 is merely an algorithm that manipulates information. Claim 2 is therefore directed to an abstract idea, and not a practical

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application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187,209 USPQ at 8). Since claim 2 is an abstract idea, and not a process, machine, article of manufacture, or composition of matter, claim 2 is non-statutory. Further, claims 3-9, 11-12 and 19, which depend either directly or indirectly from claim 2, are also merely an algorithms which manipulate descriptive data.

6. **Claims 13 and 20 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.** Claim 13 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 13, a defining step, a significance coefficient deriving step, and a reconstructed value deriving step, along with multiple iterations of the two aforementioned deriving steps, are performed on pixel data, pixel data simply being internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 13, as presently recited, does not produce a concrete, tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 13 does not have a substantial practical application since claim 13 is merely an algorithm that manipulates information. Claim 13 is therefore directed to an abstract idea, and not a practical application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187,209 USPQ at 8). Since claim 13 is an abstract

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idea, and not a process, machine, article of manufacture, or composition of matter, claim 13 is non-statutory. Further, claim 20 depends from claim 13, and is also a merely an algorithm which manipulates descriptive data.

7. **Claims 14-15 and 21 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.** Claim 14 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 14, a preprocessing step, a defining step, a significance coefficient deriving step, and a reconstructed value deriving step are performed on pixel data, pixel data simply being internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 14, as presently recited, does not produce a concrete, tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 14 does not have a substantial practical application since claim 14 is merely an algorithm that manipulates information. Claim 14 is therefore directed to an abstract idea, and not a practical application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187, 209 USPQ at 8). Since claim 14 is an abstract idea, and not a process, machine, article of manufacture, or composition of matter, claim 14 is non-statutory. Further, claims 15 and 21, which depend from claim 14, are also merely an algorithms which manipulate descriptive data.

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8. Claim 16 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 16 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 16, a defining step, a significance coefficient deriving step, and a reconstructed value deriving step are performed on pixel data, pixel data simply being internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 16, as presently recited, does not produce a concrete, tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 16 does not have a substantial practical application since claim 16 is merely an algorithm that manipulates information. Claim 16 is therefore directed to an abstract idea, and not a practical application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187, 209 USPQ at 8). Since claim 16 is an abstract idea, and not a process, machine, article of manufacture, or composition of matter, claim 16 is non-statutory.

9. Claim 17 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 17 recites a method which is merely an algorithm that is performed on descriptive data, namely stored pixel values. In claim 17, a preprocessing step, a defining step, a significance coefficient deriving step, and a reconstructed value deriving step are performed on pixel data, pixel data simply being

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internal digital data that represents values for pixels. Furthermore, these steps are clearly steps of a computer algorithm that are performed on a computer (see, e.g., page 4, lines 20-26 and page 5, lines 10-14 of the present specification). Claim 17, as presently recited, does not produce a concrete, tangible and useful result, such as the generation of a physical hardcopy output of an image created by the method. Thus, claim 17 does not have a substantial practical application since claim 17 is merely an algorithm that manipulates information. Claim 17 is therefore directed to an abstract idea, and not a practical application, and would thus seek to patent the abstract idea itself (Benson 409 U.S. at 71-72, 175 USPQ at 676; cf. Diehr, 450 U.S. at 187, 209 USPQ at 8). Since claim 17 is an abstract idea, and not a process, machine, article of manufacture, or composition of matter, claim 17 is non-statutory.

Claim Rejections - 35 USC § 112

10. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

11. Claim 22 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claims contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 22 recites an image processor which performs the steps of a method. However, there

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is no recitation of elements which would cause this image processor to actually perform the steps listed. A processor cannot in and of itself perform any steps, nor is there any description in the specification as to how an image processor could, in and of itself, perform the steps recited in claim 22. Some form of computer software encoded on a computer-readable medium is required in order to enable a computer processor, such as the claimed image processor, to carry out the steps recited in claim 22. Without such a recitation, claim 22 is not enabled by the specification.

12. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

13. Claims 2-9, 11-12 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 2 recites, in lines 8-9, "a significance coefficient that is based upon the value of *that pixel*" [emphasis added]. Does "that pixel" refer to the individual pixel recited earlier in claim 2, or does "that pixel" refer to each pixel of the neighborhood as also recited earlier in claim 2. Claim 2 could be interpreted either way. For the purpose of examining the claims over the prior art, Examiner will assume that "that pixel" refers to "each pixel of the neighborhood" since such an interpretation is consistent with the specification and has been put forth previously by Applicant.

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14. Claims 14-15 and 21 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 14 recites, in lines 10-11, "a significance coefficient that is based upon the value of *that pixel*" [emphasis added]. Does "that pixel" refer to the individual pixel recited earlier in claim 14, or does "that pixel" refer to each pixel of the neighborhood as also recited earlier in claim 14. Claim 14 could be interpreted either way. For the purpose of examining the claims over the prior art, Examiner will assume that "that pixel" refers to "each pixel of the neighborhood" since such an interpretation is consistent with the specification and has been put forth previously by Applicant.

15. Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 16 recites, in lines 7-8, "a significance coefficient that is based upon the value of *that pixel*" [emphasis added]. Does "that pixel" refer to the individual pixel recited earlier in claim 16, or does "that pixel" refer to each pixel of the neighborhood as also recited earlier in claim 16. Claim 16 could be interpreted either way. For the purpose of examining the claims over the prior art, Examiner will assume that "that pixel" refers to "each pixel of the neighborhood" since such an interpretation is consistent with the specification and has been put forth previously by Applicant.

16. Claim 17 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Claim 17 recites, in lines 9-10, "a significance coefficient that is based upon the value of *that pixel*" [emphasis added]. Does "that pixel" refer to the individual pixel recited earlier in claim 17, or does "that pixel" refer to each pixel of the neighborhood as also recited earlier in claim 17. Claim 17 could be interpreted either way. For the purpose of examining the claims over the prior art, Examiner will assume that "that pixel" refers to "each pixel of the neighborhood" since such an interpretation is consistent with the specification and has been put forth previously by Applicant.

Claim Rejections - 35 USC § 102

17. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless -
(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

18. Claims 2-4, 16 and 19 are rejected under 35 U.S.C. 102(e) as being anticipated by Fan (US Patent 6,101,285).

Regarding claims 2 and 19: Fan discloses:

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x, n)$, (m, n) , $(m+T_x, n)$) and column 6,

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lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m,n) of Fan) and additionally a plurality of pixels generated proximate said individual pixel (figure 8a($(m-T_x,n)$, $(m+T_x,n)$) of Fan).

- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving the reconstructed value of the individual pixel ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the halftone image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Further regarding claim 19: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 3: Fan discloses that said halftone image is derived from an original image having a continuous value for each pixel (column 6, lines 38-41 of Fan), and, for each individual pixel, said significance coefficient of each neighborhood pixel is an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan). As discussed above in the arguments regarding claim 2, the difference between the neighborhood pixel and the individual pixel ($dif0$ or $dif1$) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan), which sets the significance coefficient (column 7, lines 54-58 of Fan). The difference between the neighborhood pixel and the individual pixel is an indication of the likelihood that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image since, the higher the level of difference, the less likely it is that the value of that neighborhood pixel in the original image is correlated with the value of the individual pixel in the original image.

Regarding claim 4: Fan discloses deriving a baseline value ($x*(m,n)$) for the individual pixel (column 6, lines 47-50 of Fan), and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel

and of the baseline value for the individual pixel (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan).

Regarding claim 16: Fan discloses:

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x, n)$), (m, n), ($m+T_x, n$)) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m, n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a($(m-T_x, n)$), ($m+T_x, n$)) of Fan).
- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving the reconstructed value of the individual pixel ($y(m, n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the first value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Claim Rejections - 35 USC § 103

19. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

20. Claims 1, 5, 11-15, 17-18 and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fan (US Patent 6,101,285) in view of Wong (US Patent 5,506,699).

Regarding claims 1 and 18: Fan discloses:

- for each pixel, defining a respective neighborhood (figure 8a(($m-T_x, n$), (m, n), ($m+T_x, n$)) and column 6, lines 42-47 of Fan) containing that pixel (figure 8a(m, n) of Fan) and other pixels (figure 8a(($m-T_x, n$), ($m+T_x, n$)) of Fan).
- in a first iteration, obtaining for each individual pixel a continuous value ($y(m, n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) by summing the products of weighting values (α and $(1-\alpha)$) and the continuous values of the pixels in the neighborhood of the individual pixel (column 7, lines 48-58 of Fan), the weighting values being derived from the continuous values of the halftoned image (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The weighting values for the neighborhood pixels (α and $(1-\alpha)$) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be

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performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

Fan does not disclose expressly that said values of the pixels are binary values; and, in further iterations, obtaining for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to begin with binary image data, as taught by Wong, which would modify the teaching of Fan such that only one location is within the pixel window for pixel processing. The suggestion for doing so would have been that binary image data is the simplest image data to start with and would also simplify the individual pixel value determination step taught by Fan.

Furthermore, at the time of the invention, it would have been

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obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, in further iterations, Fan in view of Wong obtains for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 1 and 18.

Further regarding claim 18: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 5: Fan does not disclose expressly that the baseline value for the individual pixel is derived by low pass filtering of the halftone image.

Wong discloses deriving a baseline value for the individual pixels by low pass filtering the halftone image (figure 2(18) and column 5, lines 6-9 and lines 13-17 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a low pass filter to obtain the baseline value, as

taught by Wong. The motivation for doing so would have been to avoid overly blurring the resultant image (column 5, lines 16-19 of Wong). Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 5.

Regarding claim 11: Fan does not disclose expressly forming an enhanced reconstructed image as a linear combination of said reconstructed image and a continuous image derived from said halftone image by a second image reconstruction method.

Wong discloses forming an enhanced reconstructed image as a linear combination of said reconstructed image (figure 3(24) of Wong) and a continuous image derived from said halftone image by a second image reconstruction method (figure 3(26) of Wong) (column 6, lines 35-37 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use a final low pass filter in linear combination with the reconstructed image, as taught by Wong. The motivation for doing so would have been to remove unwanted high frequency components that may be generated at the final stage of continuous-tone image reconstruction (column 6, lines 35-37 of Wong). Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 11.

Further regarding claim 12: Wong discloses that said second image reconstruction method is a low pass filter (figure 3(26) and column 6, lines 35-37 of Wong).

Regarding claims 13 and 20: Fan discloses:

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x, n)$, (m, n) , $(m+T_x, n)$) and column 6,

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lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m,n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a($(m-T_x,n), (m+T_x,n)$) of Fan).

- deriving for each pixel of said first neighborhood, a respective significance coefficient (α) (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving a first reconstructed value of the individual pixel ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the neighborhood pixels of a product of the halftone image value at that neighborhood pixel with the respective significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Fan does not disclose expressly M further steps, $m=1, \dots, M$ ($M \geq 1$), of: for successive individual ones of said pixel: rederiving a significance coefficient for each neighborhood pixel; and deriving an $(m+1)$ -th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m -th reconstructed value at that neighborhood

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pixel with the significance coefficient of that neighborhood pixel.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, Fan in view of Wong would perform M further steps, $m=1, \dots, M$ ($M \geq 1$), of: for successive individual ones of said pixel: rederiving a significance coefficient for each neighborhood pixel; and deriving an $(m+1)$ -th reconstructed value of the individual pixel as a sum over the neighborhood pixels of the product of the m -th reconstructed value at that neighborhood pixel with the significance coefficient of that neighborhood pixel. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 13 and 20.

Further regarding claim 20: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claims 14, 17 and 21: Fan discloses, for successive pixels (figure 4(320) and column 6, lines 38-41 of Fan):

- defining a set of neighborhood pixels of the individual pixel (figure 8a($(m-T_x, n)$, (m, n) , $(m+T_x, n)$) and column 6, lines 42-47 of Fan), the set of neighborhood pixels including the individual pixel (figure 8a(m, n) of Fan) and additionally a plurality of pixels proximate said individual pixel (figure 8a($(m-T_x, n)$, $(m+T_x, n)$) of Fan).
- deriving for each pixel of the neighborhood, a significance coefficient (α) that is based upon the value of that pixel (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The significance coefficients for the neighborhood pixels (α) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel (dif0 or dif1) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).
- deriving the reconstructed value of the individual pixel ($y(m, n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) as a sum over the pixels of the neighborhood of a product of the image value at that neighborhood pixel with the significance coefficient of that neighborhood pixel (column 7, lines 48-58 of Fan).

Fan does not disclose expressly preprocessing the halftone image by a filtering algorithm to derive a preprocessed image having a preprocessed image value for each of said pixel.

Wong discloses preprocessing the halftone image by a filtering algorithm (figure 2(18) of Wong) to derive a preprocessed image having a preprocessed image value for each of said pixels (column 5, lines 6-8 of Wong). The first stage by which the initial binary data is processed in a low-pass filter (figure 2(18) and column 5, lines 7-8 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to preprocess the halftone image, as taught by Wong, before performing the method taught by Fan. The motivation for doing so would have been to remove unwanted high frequency components (column 5, lines 13-16 of Wong) from the halftone binary image. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claims 14, 17 and 21.

Further regarding claim 17: The "first value" recited in claim 17 corresponds to the "halftone image value" recited in claim 14. Further, the "first image" recited in claim 17 corresponds to the "halftone image" recited in claim 14. Therefore, the limitations of claim 17 are fully embodied within the limitations recited in claim 14.

Further regarding claim 21: Fan discloses performing the method using a computer program product which is readable by a computing device to cause the computing device to perform said method (column 5, lines 19-27 of Fan).

Regarding claim 15: Fan discloses deriving a baseline value ($x^*(m,n)$) for the individual pixel (column 6, lines 47-50 of Fan), and deriving said significance coefficient as a function of the halftone value for the image at that neighborhood pixel and of the baseline value for the individual pixel (column 6, lines 51-58; and column 7, lines 29-43 and lines 54-58 of Fan). By combination with Wong, said halftone value for the image at that neighborhood pixel is a preprocessed value.

Regarding claim 22: Fan discloses an apparatus (figure 9 of Fan) comprising:

- an image receiver (figure 9(802) of Fan) for receiving a first image (column 5, lines 40-45 of Fan).
- an image processor (figure 9(804) and column 5, lines 24-25 of Fan) which performs the steps of:
 - for each pixel, defining a respective neighborhood (figure 8a($(m-T_x, n)$), ((m,n)), ($(m+T_x, n)$)) and column 6, lines 42-47 of Fan) containing that pixel (figure 8a((m,n)) of Fan) and other pixels (figure 8a($(m-T_x, n)$), ($(m+T_x, n)$) of Fan).
 - in a first iteration, obtaining for each individual pixel a continuous value ($y(m,n)$) (figure 4(310-316) and column 7, lines 1-15 of Fan) by summing the products of weighting values (α and $(1-\alpha)$) and the continuous values of the pixels in the neighborhood of the individual pixel (column 7, lines 48-58 of Fan), the weighting values being derived from the continuous values of the halftoned image (column 6, lines 52-58; and column 7, lines 29-43 and lines 54-58 of Fan). The weighting values for the neighborhood pixels (α and

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($1-\alpha$) are set based on the amount of edge enhancement that is to be performed (column 7, lines 54-58 of Fan). The amount of edge enhancement that is to be performed is directly determined from the values of the neighborhood pixels since the difference between the neighborhood pixel and the individual pixel ($dif0$ or $dif1$) is calculated (column 6, lines 52-58 of Fan) and the calculation of said difference used to determine the amount of edge enhancement that is to be performed (column 7, lines 29-43 of Fan).

Fan does not disclose expressly that said values of the pixels are binary values; and, in further iterations, obtaining for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration.

Wong discloses performing the conversion of binary image data (column 4, lines 48-53 of Wong) into continuous value image data (column 5, lines 4-9 of Wong) through the application of multiple iterations (figure 3 and column 5, lines 6-13 of Wong).

Fan and Wong are combinable because they are from the same field of endeavor, namely the conversion of binary image data into continuous-tone image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to begin with binary image data, as taught by Wong, which would modify the teaching of Fan such that only one location is within the pixel window for pixel processing. The suggestion for doing so would have been that binary image data is the

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simplest image data to start with and would also simplify the individual pixel value determination step taught by Fan. Furthermore, at the time of the invention, it would have been obvious to a person of ordinary skill in the art to use multiple iterations, as taught by Wong. Thus, in further iterations, Fan in view of Wong obtains for each individual pixel a continuous value by summing the products of the weighting values and the continuous values of the pixels in the neighborhood of the individual pixel obtained at the previous iteration, the weighting values being derived from the continuous values obtained in at least one previous said iteration. The motivation for doing so would have been that multiple passes of the image enhancement would improve the overall result since, by running just one pass with the system of Fan, there are still likely to be edge artifacts that need smoothing, along with other artifacts that need correction. Therefore, it would have been obvious to combine Wong with Fan to obtain the invention as specified in claim 22.

21. Claims 6-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fan (US Patent 6,101,285) in view of Wong (US Patent 5,506,699) and obvious engineering design choice.

Regarding claim 6: Fan discloses that, for each individual pixel, the significance coefficient for each neighborhood pixel is an increasing function $f(v)$ of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel (column 7, lines 48-58 of Fan). For an increasing absolute difference between a pixel and a neighboring pixel, the value of the significance coefficient (α) increases (column 7, lines 48-58 of Fan).

Fan in view of Wong does not disclose expressly that $f(v)$ is a decreasing function. However, it would have been an obvious engineering design choice to set the function $f(v)$ to be a decreasing function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel. All that this would require is that the equation for $y(m,n)$ (column 7, lines 51-53 of Fan) be reformatted to read: $y(m,n) = (1-\alpha)x^*(m-T_x,n) + \alpha x^*(m,n)$ when $|dif0| \leq |dif1|$ and $y(m,n) = (1-\alpha)x^*(m+T_x,n) + \alpha x^*(m,n)$ otherwise. In this formulation, the value of α would be a decreasing function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel, but nothing in the actual substance of the system would change. The only change would be in exactly how the equations were formulated, specifically where α is used and where $(1-\alpha)$ is used.

Regarding claims 7 and 8: Fan discloses that $f(v)$ increases as a function of the absolute difference between the halftone value at that neighborhood pixel and the baseline value for the individual pixel (column 7, lines 48-58 of Fan). While $f(\alpha)$ can be seen to be smooth since α increases or decreases based on the amount of edge enhancement needed (column 7, lines 54-58 of Fan), the value upon which the significance coefficient depends, namely σ , is a parameter that can be set by the user (column 6, lines 55-65 of Fan). Furthermore, the nature of how $f(\alpha)$ is established reasonably suggests that $f(\alpha)$ is not necessarily linear (column 6, lines 50-67 of Fan). Thus, $f(\alpha)$ is both a non-linear function and a continuous (smooth) function.

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Regarding claim 9: Fan in view of Wong and obvious engineering design choice teaches that $f(v)$ is a function of the form $f(v)=a(1-v/b)^k$ where a and b are predefined numbers and k is a predefined integer for the following reasons:

1. Fan teaches that $f(v)$ is an increasing function of v ,
or: $f(v) \propto v^k$ where k is a predefined integer.
2. By normalization, which is a common practice and could be considered part of the obvious engineering design choice for the function, $f(v) \propto a\left(\frac{v}{b}\right)^k$ where a and b are predefined numbers and k is a predefined integer.
3. As per the arguments regarding claim 6, the combination of Fan in view of Wong and obvious engineering design choice sets forth that $f(v)$ is a *decreasing* function such that $(1-\alpha)$ is used in the resulting output equations where α was previously used. Thus, a corresponding change in $f(v)$ set forth above would result in $f(v)=a(1-v/b)^k$ where a and b are predefined numbers and k is a predefined integer.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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14 September 2006



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